WHAT WE CLAIM ARE:

1.   A solid state image pickup device comprising:

a semiconductor substrate having a first layer of a first conductivity type;

5   a second layer of a second conductivity type opposite to the first conductivity type, said second conductivity type layer being formed on the first conductivity type layer of said semiconductor substrate;

a first region of the first conductivity type formed in said second conductivity type layer and constituting a photodiode with said second conductivity

10   type layer;

a first gate structure including a charge storage region and a control gate, said first gate structure being formed on a surface of said semiconductor substrate adjacent to a portion of said first region;

a second region of the first conductivity type formed adjacent to said

15   first gate structure on a side opposite to said first region, and constituting a non-volatile memory element with said first region and said first gate structure; and

a control circuit for applying a first write voltage to the control gate of said first gate structure, the first write voltage being a write voltage for tunneling and injecting charges accumulated in said first region into the charge storage region.

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2.   The solid state image pickup device according to claim 1, wherein said control circuit applies a second write voltage to the control gate of said first gate structure and to the second region after the first write voltage is applied, the second write voltage being a write voltage for injecting charges accumulated in said first region

25   into the charge storage region as hot carrier injection.

3. The solid state image pickup device according to claim 1, further comprising:

a second gate structure of an insulated gate type formed adjacent to another portion of said first region; and

a third region of the first conductivity type formed adjacent to a side of

5 said second gate structure opposite to said first region, said third region constituting an insulated gate type transistor with said first region and said second gate structure.

4. The solid state image pickup device according to claim 1, further comprising a

10 third region of the first conductivity type projecting from an upper surface of the first conductivity type layer of said semiconductor substrate into said second conductivity type layer.

5. The solid state image pickup device according to claim 1, wherein the charge

15 storage region of the non-volatile memory element has a floating gate.

6. The solid state image pickup device according to claim 1, wherein the charge storage region of the non-volatile memory element has an interface between a silicon nitride film and a silicon oxide film.

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7. A solid state image pickup device comprising:

a semiconductor substrate having a first layer of a first conductivity;

a second layer of a second conductivity type opposite to the first conductivity type, said second conductivity type layer being formed on the first

25 conductivity type layer of said semiconductor substrate;

a first region of the first conductivity type formed in said second

conductivity type layer and constituting a photodiode with said second conductivity type layer;

a first gate structure including a charge storage region and a control gate, said first gate structure being formed on a surface of said semiconductor

5　substrate adjacent to a portion of said first region;

a second region of the first conductivity type constituting a non-volatile memory element with said first region and said first gate structure, formed adjacent to said first gate structure on a side opposite to said first region ;

a second gate structure of an insulated gate type formed adjacent to

10　another portion of said first region; and

a third region of the first conductivity type formed adjacent to said second gate structure on a side opposite to said first region, said third region constituting an insulated gate type transistor with said first region and said second gate structure.

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8.　The solid state image pickup device according to claim 7, further comprising a control circuit for applying a bias voltage to said second gate structure to turn on the insulated gate type transistor and supplying current to the non-volatile memory element.

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9.　The solid state image pickup device according to claim 7, wherein the charge storage region of the non-volatile memory element has a floating gate.

10.　The solid state image pickup device according to claim 7, wherein the charge

25　storage region of the non-volatile memory element has an interface between a silicon nitride film and a silicon oxide film.

11.   A solid state image pickup device comprising:

a semiconductor substrate having a first layer of a first conductivity;

a layer of a second conductivity type opposite to the first conductivity

5   type, said second conductivity type layer being formed on the first conductivity type

layer of said semiconductor substrate;

a first region of the first conductivity type formed in said second

conductivity type layer and constituting a photodiode with said second conductivity

type layer;

10   a first gate structure including a charge storage region and a control

gate, said first gate structure being formed on a surface of said semiconductor

substrate adjacent to a portion of said first region;

a second region of the first conductivity type formed adjacent to said

first gate structure on a side opposite to said first region, and constituting a non-

15   volatile memory element with said first region and said first gate structure; and

a control circuit for applying a forward bias voltage to the first

conductive type layer of said semiconductor substrate to supply current to the non-

volatile memory element.

20   12.   The solid state image pickup device according to claim 11, further comprising

a third region of the first conductivity type projecting from an upper surface of the

first conductivity type layer of said semiconductor substrate into said second

conductivity type layer.

25   13.   The solid state image pickup device according to claim 11, wherein the charge

storage region of the non-volatile memory element has a floating gate.

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14.   The solid state image pickup device according to claim 11, wherein the charge

storage region of the non-volatile memory element has an interface between a

silicon nitride film and a silicon oxide film.

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15.   A driving method for a solid state image pickup device, comprising the steps

of:

(a) applying light to photodiodes distributed in a matrix layout and

accumulating charges representative of image information, said photodiodes being

10   formed in a second conductivity type layer formed on a first conductivity type layer

of a semiconductor substrate, the first conductivity type being opposite to the

second conductivity type;

(b) applying a first write control voltage to a control gate of a non-

volatile memory element having a charge storage region, the control gate and a

15   drain region, the non-volatile memory element being formed adjacent to each of the

photodiodes, and tunneling and injecting at least a portion of the charges

representative of the image information into the charge storage region as signal

charges; and

(c) applying a read control voltage to the non-volatile memory

20   element to detect a threshold voltage corresponding to an amount of the signal

charges injected at said step (b) into the charge storage region.

16.   The driving method for a solid state image pickup device according to claim 15,

further comprising a step of, before said step (c):

25   (d) applying a second write control voltage to the control gate and

drain region of the non-volatile memory element and injecting as hot carriers at least

a portion of the charges representative of the image information into the charge storage region as signal charges.

17.   The driving method for a solid state image pickup device according to claim 15, wherein said step (c) includes a sub-step of:

(e) applying a bias voltage to an insulated gate type transistor formed adjacent to another portion of each of the photodiodes to turn on the transistor and supply a channel current to the non-volatile memory element.

18.   The driving method for a solid state image pickup device according to claim 15, wherein said step (c) includes a sub-step of:

(f) applying a forward bias voltage to the first conductivity type layer of the semiconductor substrate to supply a channel current to the non-volatile memory element.

19.   The driving method for a solid state image pickup device according to claim 15, wherein said step (c) includes a sub-step of:

(g) applying a forward bias voltage to a first region of the first conductivity type formed projecting from an upper surface of the first conductivity type layer of the semiconductor substrate into the second conductivity type layer to supply a channel current to the non-volatile memory element.

20.   The driving method for a solid state image pickup device according to claim 15, further comprising a step of, before said step (a):

(h) applying a reverse bias voltage to the first conductivity type layer of the semiconductor substrate to drain charges accumulated beforehand in the

photodiodes to a semiconductor substrate side.